



© 2026 the authors. This is an open access article under the terms of the Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License.

1. Sima. Akbary¹: Department of Educational Studies and Curriculum Planning, Mara.C., Islamic Azad University, Marand, Iran
2. Shahram. Ranjdoust²: Department of Educational Studies and Curriculum Planning, Mara.C., Islamic Azad University, Marand, Iran (Email: dr.ranjdoust@iau.ac.ir)

Article type:
Original Research

Article history:
Received 25 December 2025
Revised 22 April 2026
Accepted 29 April 2026
Initial Publish 03 May 2026
Published online 01 September 2026

How to cite this article:

Akbary, S., & Ranjdoust, S. (2026). Designing a Conceptual Model of a Curriculum Based on Artificial Intelligence Literacy Education. *Assessment and Practice in Educational Sciences*, 4(5), 1-16. <https://doi.org/10.61838/japes.251>

Designing a Conceptual Model of a Curriculum Based on Artificial Intelligence Literacy Education

ABSTRACT

The present study was conducted with the aim of designing a conceptual model of a curriculum based on artificial intelligence literacy education. This study adopted a qualitative approach and employed thematic analysis and the Glaserian approach as the research methodology. Since the study had an exploratory nature and was conducted with the purpose of expanding knowledge and increasing awareness in the field of artificial intelligence literacy education, it is categorized as an applied study. The statistical population included artificial intelligence specialists, education experts, curriculum planners, textbook authors, and secondary school teachers in West Azerbaijan Province. The sampling method was purposive and snowball sampling, which continued until theoretical saturation was achieved (15 interviews). The data analysis process was conducted in three stages: initial coding, axial coding, and selective coding. Finally, the collected and coded data were analyzed using MAXQDA software. Using thematic analysis, 85 initial open codes were extracted and categorized within the framework of conceptual components through axial and selective coding into six main dimensions, including cognitive competencies, skill-based competencies, attitudinal and ethical competencies, curriculum components, teaching-learning strategies and evaluation, and implementation requirements and contexts. At the end of the three-stage coding process, the final research model was developed through the integration of these dimensions, and the reliability of the research model was reported as 0.758.

Keywords: Curriculum, Artificial Intelligence Literacy, Model Design

Introduction

Artificial intelligence has become one of the most influential forces reshaping contemporary education, curriculum design, teacher professional development, and learning management. In recent years, educational systems have increasingly moved from viewing artificial intelligence merely as a technological tool toward understanding it as a broader pedagogical, cultural, ethical, and organizational phenomenon. This shift has created a need for curriculum models that prepare learners not only to use AI-based tools but also to understand their logic, evaluate their outputs critically, recognize their ethical implications, and apply them responsibly in educational, professional, and social contexts. The growing body of research on AI in education

shows that artificial intelligence can support personalized learning, improve access to educational resources, facilitate adaptive feedback, strengthen teacher decision-making, and create new possibilities for competence-based education (1, 2). However, the effective integration of AI into education requires systematic curricular planning rather than fragmented or tool-centered adoption.

The concept of artificial intelligence literacy has emerged as a response to this need. AI literacy refers to a set of cognitive, technical, ethical, and social competencies that enable individuals to understand, use, evaluate, and critically engage with AI systems. In the school context, AI literacy is not limited to programming skills or technical knowledge; rather, it includes understanding how AI systems process data, how algorithms generate outputs, how bias may be embedded in automated systems, and how learners can use AI tools responsibly in academic and everyday situations. A systematic review of AI literacy and competency in K–12 education indicates that defining, enhancing, and assessing AI literacy requires attention to conceptual understanding, practical application, ethical awareness, and assessment frameworks suited to learners' developmental levels (3). Therefore, any curriculum model based on AI literacy must be multidimensional and should address knowledge, skills, attitudes, values, teaching strategies, assessment methods, and implementation requirements.

The increasing presence of AI in high school education further emphasizes the necessity of curriculum-based intervention. Secondary education is a critical stage because students are cognitively prepared to understand abstract technological concepts while also forming academic, occupational, and social orientations that will influence their future learning pathways. Reviews of AI use in high school settings show that AI can support learning, feedback, content creation, and student engagement, but its effectiveness depends on whether students and teachers possess the necessary competencies to use these technologies critically and purposefully (4). Without structured curriculum design, AI use may remain superficial, dependent on individual teacher interest, or limited to uncritical use of generative tools. Accordingly, AI literacy education in secondary schools requires a coherent conceptual model that specifies educational objectives, content organization, learning activities, assessment practices, and institutional supports.

From a curriculum studies perspective, the integration of AI literacy should be aligned with broader educational transformation. AI-driven curriculum design is increasingly discussed in relation to aesthetic education, ideological and political education, vocational learning, entrepreneurship education, and professional training. Studies on AI-driven curriculum development emphasize that educational programs must move beyond content transmission and instead develop higher-order competencies such as creativity, critical thinking, adaptability, problem-solving, and responsible technology use (5, 6). In this sense, AI literacy education is closely related to competence-based curriculum design because it focuses on what learners can understand, perform, evaluate, and create through informed interaction with AI systems.

Teacher competence is one of the most important conditions for implementing AI literacy curricula. Teachers are not only users of AI tools but also mediators of students' understanding, ethical judgment, and practical engagement with technology. Research on vocational teachers' AI competencies shows that teachers require knowledge of AI concepts, skills in designing AI-supported learning activities, and the ability to evaluate students' use of AI in authentic learning situations (7). Similarly, studies on teacher support in higher education indicate that AI can assist instructional planning, feedback, assessment, and classroom management, but these benefits depend on teachers' preparedness and institutional support (8). Therefore, a curriculum model for AI literacy must include teacher empowerment as an essential implementation requirement.

The professional empowerment of teachers in AI-based education also includes technological literacy, pedagogical redesign, ethical awareness, and confidence in using intelligent systems. Studies on the role of AI in education and teacher professional empowerment highlight that teachers need continuous professional development to integrate AI meaningfully into teaching rather than using it as an isolated digital accessory (9). In addition, the updating of teacher training programs has been identified

as a necessary response to the relationship between AI and media literacy, especially because teachers must help learners identify misinformation, evaluate digital content, and understand algorithmic mediation in contemporary media environments (10). Thus, AI literacy curricula should be accompanied by professional development programs that prepare teachers for both technical and critical dimensions of AI education.

Another important dimension of AI literacy is ethical and responsible use. Artificial intelligence introduces new concerns related to academic integrity, data privacy, algorithmic bias, intellectual property, transparency, and dependence on automated systems. Research on AI-supported college students with attention-deficit/hyperactivity disorder demonstrates that AI may provide cognitive and emotional support, but its use also raises ethical questions concerning autonomy, privacy, fairness, and responsible intervention (11). These concerns are not limited to special education or higher education; they are relevant to all educational settings in which learners interact with generative AI, adaptive platforms, or automated decision systems. Consequently, AI literacy education should cultivate digital responsibility and ethical judgment alongside technical skills.

The ethical dimension of AI literacy is also linked to educational equity and social justice. AI systems may reproduce or amplify inequalities if learners do not understand how data, algorithms, and institutional contexts shape technological outcomes. Studies on attitudes toward AI in medical education and professional communication show that students may have positive expectations about AI while also expressing concerns about accuracy, trust, and ethical use (12). Similarly, research on AI in academic environments suggests that AI may reduce or increase foreign language anxiety depending on how it is implemented, how learners perceive it, and whether it supports or undermines learner confidence (13). These findings imply that AI literacy curricula must address the psychological, emotional, and social consequences of AI use, not merely its instrumental benefits.

Soft skills are another major component of AI-based education. As AI increasingly automates routine tasks, human competencies such as communication, collaboration, creativity, adaptability, empathy, and ethical reasoning become more important. Studies have emphasized the contribution of AI to developing soft skills for future educators and students, showing that AI-supported environments can create opportunities for reflective learning, simulation, feedback, and collaborative problem-solving (14, 15). Therefore, a curriculum based on AI literacy should not be restricted to computer science or technology education. It should be designed as an interdisciplinary program that strengthens both digital competencies and human-centered capabilities.

The relationship between AI and educational leadership further supports the need for a systematic curriculum model. Educational leaders play a crucial role in policy development, resource allocation, teacher empowerment, ethical governance, and institutional readiness. A comprehensive taxonomy of AI in educational leadership indicates that AI affects decision-making, strategic planning, instructional supervision, data-informed management, and future directions of educational institutions (16). In school systems, successful AI literacy education requires leadership that can provide technological infrastructure, develop implementation guidelines, support teachers, and ensure alignment between innovation and educational values. Without such leadership, AI integration may remain inconsistent and unsustainable.

At the same time, AI literacy must be understood as part of a broader digital culture in education. Quality education in the age of AI requires learners and teachers to develop a culture of critical, creative, ethical, and purposeful engagement with digital technologies. The need for digital culture in teaching has been emphasized as a prerequisite for using AI to improve educational quality, because technological innovation alone cannot guarantee meaningful learning (17). Digital culture includes attitudes toward innovation, openness to continuous learning, awareness of digital risks, and the ability to participate responsibly in technology-mediated environments. Therefore, curriculum design for AI literacy should integrate cognitive, skill-based, attitudinal, and cultural dimensions.

AI is also transforming specialized fields of education, which demonstrates its interdisciplinary relevance. In entrepreneurship education, AI is reshaping how learners identify opportunities, analyze markets, develop business models, and respond to uncertainty (18). In human resource management and circular economy transitions, AI is conceptualized as a strategic tool for organizational transformation and sustainability-oriented decision-making (19). In animation and creative professional training, AI influences curriculum design, professional competencies, and the future of creative labor (20). These examples show that AI literacy is not a narrow technical competence but a foundational capacity required across different educational and occupational domains.

The integration of AI into ideological, cultural, and values-based education has also expanded the scope of AI literacy. AI-driven communication modes in ideological and political education demonstrate how intelligent technologies can personalize content, improve communication efficiency, and reshape educational interaction (21). Similarly, reflections on AI-enabled precision development in ideological and political education highlight the potential of intelligent systems to support targeted educational interventions while also requiring careful attention to values, ethics, and learner autonomy (6). These discussions are relevant for curriculum design because AI literacy must prepare students to understand not only how AI functions but also how it influences culture, identity, values, and social communication.

In addition, AI literacy education must consider teachers' self-efficacy and classroom-level implementation. Research on AI integration and teachers' self-efficacy in physics classrooms shows that teachers' beliefs about their ability to use AI influence the extent and quality of AI adoption in instruction (22). When teachers perceive AI as pedagogically useful and manageable, they are more likely to integrate it into learning activities. Conversely, low self-efficacy may lead to resistance, superficial use, or avoidance. Thus, curriculum models must incorporate teacher readiness, professional learning, and practical support mechanisms as part of implementation planning.

Managerial and organizational perspectives are also essential in designing AI literacy curricula. Studies on empowering managers of entrepreneurial schools through AI show that school management requires new capacities for innovation, strategic planning, data-informed leadership, and technological governance (23). These managerial competencies are closely connected to curriculum implementation because school leaders determine whether teachers receive training, whether infrastructure is available, whether policies are clarified, and whether AI-related initiatives become sustainable. Accordingly, the design of an AI literacy curriculum must include executive requirements and organizational contexts rather than focusing only on classroom content.

The development of AI literacy curricula also requires localization and contextual adaptation. Educational systems differ in terms of cultural values, policy frameworks, technological infrastructure, teacher preparation, and student access to digital tools. Therefore, AI literacy models should not be imported mechanically from other contexts; they should be adapted to local educational needs and institutional realities. Studies in diverse fields, including religious, cultural, social, and managerial education, indicate that AI-related educational initiatives must be sensitive to local values and contextual priorities (24). This is particularly important in curriculum design, where objectives, content, examples, ethical scenarios, and assessment methods must be meaningful for learners' lived educational environment.

A major challenge in AI literacy education concerns assessment. Traditional assessment methods are often insufficient for evaluating students' ability to interact with AI systems, analyze generated outputs, identify errors, recognize bias, and apply ethical judgment. Assessment in AI literacy should therefore include performance-based tasks, project-based evaluation, portfolios, self-assessment, rubrics, and practical demonstrations. Since AI literacy includes knowledge, skills, attitudes, and ethical awareness, assessment should be multidimensional and process-oriented. This view is consistent with research emphasizing that AI competencies must be defined, enhanced, and assessed through systematic frameworks rather than isolated

technological activities (3). Therefore, curriculum design must connect objectives, content, pedagogy, and assessment in an integrated structure.

Teaching–learning strategies are another central part of AI literacy curriculum design. Active learning, project-based learning, inquiry-based learning, collaborative learning, case analysis, simulation, challenge-based instruction, and ethical scenario analysis are particularly suitable for AI literacy because they allow learners to experience AI as a practical and social phenomenon. Research on the synergy between AI and education emphasizes that AI can support more interactive, adaptive, and learner-centered pedagogies when it is embedded in sound instructional design (1). Likewise, work on AI and soft skills shows that meaningful engagement with AI can strengthen communication, collaboration, and reflective thinking when instructional strategies are intentionally designed (15). Therefore, teaching methods in AI literacy curricula should move beyond lectures and should engage students in authentic problem-solving.

Despite the expanding literature on AI in education, several gaps remain. Many studies examine AI tools, teacher attitudes, professional development, educational leadership, or domain-specific applications, but fewer studies provide an integrated conceptual model for curriculum design based on AI literacy, especially for secondary education. Existing research confirms the importance of AI competencies, ethical awareness, teacher empowerment, technological infrastructure, and leadership support (7, 8, 16). However, there is still a need to organize these elements into a coherent curriculum model that identifies major dimensions, components, indicators, and implementation requirements. Such a model can help policymakers, curriculum planners, school leaders, and teachers move from scattered AI use toward systematic AI literacy education.

Furthermore, the rapid pace of AI development makes curriculum design both urgent and complex. AI tools evolve faster than traditional curriculum revision cycles, which means that AI literacy curricula must be flexible, future-oriented, and adaptable. Future education requires learners who can continue learning, revise their competencies, evaluate new technologies, and respond critically to emerging AI applications (2). The curriculum should therefore emphasize lifelong learning, future readiness, and adaptive capacity. In this regard, AI literacy is not only a subject to be taught but also a framework for preparing students to live, learn, work, and participate ethically in AI-mediated societies.

Overall, the literature shows that AI literacy education requires a comprehensive conceptual model that integrates cognitive competencies, skill-based competencies, attitudinal and ethical competencies, curriculum components, teaching–learning and assessment strategies, and executive requirements. Such a model should be grounded in expert perspectives, aligned with educational transformation, sensitive to contextual needs, and capable of guiding curriculum design at the secondary school level. By synthesizing the insights of AI specialists, education experts, curriculum planners, textbook authors, and teachers, it becomes possible to develop a curriculum model that is both theoretically meaningful and practically applicable. Therefore, the aim of the present study was to design a conceptual model of a curriculum based on artificial intelligence literacy education.

Methods and Materials

The present study was applied in terms of purpose and constituted a qualitative study based on the grounded theory approach. The research was conducted through interviews and thematic and structural analysis of the interviews. The statistical population included artificial intelligence specialists, education experts, curriculum planners, textbook authors, and secondary school teachers in West Azerbaijan Province. The sampling method was purposive and snowball sampling, which continued until theoretical saturation was achieved (15 interviews). Semi-structured interviews (formal semi-structured interviews) were used as the data collection method in this qualitative study. MAXQDA software was utilized for analyzing the collected data and materials.

Findings and Results

This section presents the findings obtained from the thematic analysis of in-depth interviews with experts aimed at identifying the dimensions, components, and indicators, as well as designing and validating an optimal curriculum based on artificial intelligence literacy education. First, Table 1 presents the characteristics of the interview participants.

Table 1. Characteristics of the Interview Participants

Participant Code	Gender	Educational Degree	Field of Study	Position/Occupation	Teaching or Management Experience (Years)
P1	Male	PhD	Educational Sciences	Faculty Member	18
P2	Female	PhD	Educational Psychology	Faculty Member	15
P3	Male	PhD	Educational Management	Department Head	20
P4	Male	PhD	Software Engineering	Faculty Member	14
P5	Female	PhD	Curriculum Planning	Faculty Member	12
P6	Male	PhD	Educational Sciences	Vice Chancellor for Education	22
P7	Male	Master's Degree	Educational Psychology	LMS System Manager	10
P8	Female	PhD	Educational Psychology	Faculty Member	16
P9	Male	PhD	Information Technology Management	Organizational Consultant	19
P10	Female	PhD	Educational Technology	Faculty Member	13
P11	Male	PhD	Educational Sciences	Faculty Member	17
P12	Male	Master's Degree	Computer Science	Technology Specialist	11
P13	Female	PhD	Educational Planning	Faculty Member	14
P14	Male	PhD	Educational Management	Dean of Faculty	23
P15	Female	PhD	Educational Sciences	Researcher	12

Thematic analysis was employed for analyzing the qualitative data. For this purpose, the conducted interviews were transcribed and then reviewed several times with precision. Subsequently, the coding process was performed in three stages:

1. Initial (Open) Coding: Extraction of initial concepts from the statements and expressions of the interviewees.
2. Axial Coding: Categorization of similar codes and formation of conceptual components.
3. Selective Coding: Abstraction of the main dimensions and final organization of the themes.

Initial (Open) Coding

During the initial (open) coding stage, the transcribed text of the semi-structured interviews was reviewed repeatedly and line by line. The purpose of this stage was to identify the initial and meaningful concepts embedded in the participants' statements. Each meaningful sentence or phrase referring to the effectiveness of virtual education, the role of artificial intelligence, related challenges, requirements, or consequences was considered an open code.

Table 2. Open Coding Extracted from the Interviews

Row	Extracted Open Code	Interview Number
1	Understanding the concept of artificial intelligence	P1
2	Distinguishing artificial intelligence from traditional programming	P1
3	Familiarity with machine learning	P2
4	Understanding the role of data in AI performance	P2
5	Understanding decision-making algorithms	P3
6	Understanding the response-generation mechanism in generative tools	P3
7	Familiarity with the concept of neural networks	P4
8	Understanding educational implications of AI	P4
9	Awareness of the limitations of artificial intelligence	P5
10	Understanding the concept of training data	P5
11	Recognition of algorithmic error	P6
12	Familiarity with the concept of language models	P6
13	Understanding automated content generation	P7
14	Understanding the concept of big data	P7

15	Familiarity with digital transformation	P8
16	Ability to work with artificial intelligence tools	P8
17	Skill in writing effective prompts	P9
18	Ability to analyze outputs from tools such as ChatGPT	P9
19	Skill in comparing human and AI responses	P10
20	Ability to identify content-related errors	P10
21	Skill in revising generated responses	P11
22	Purposeful use of AI in educational projects	P11
23	Ability to evaluate information credibility	P12
24	Problem-solving skills using AI assistance	P12
25	Ability to generate educational content using AI	P13
26	Skill in integrating human and AI resources	P13
27	Time management using intelligent tools	P14
28	Critical use of search results	P14
29	Ability to formulate precise requests	P15
30	Teamwork skills in technology-based projects	P15
31	Acceptance of responsibility in AI usage	P1
32	Sensitivity toward plagiarism	P2
33	Attention to data privacy	P3
34	Critical attitude toward technology	P3
35	Avoidance of complete dependence on AI	P4
36	Respect for intellectual property	P4
37	Awareness of algorithmic bias	P5
38	Understanding the social consequences of AI	P5
39	Attention to educational equity	P6
40	Digital responsibility	P6
41	Positive attitude toward innovation	P7
42	Readiness for lifelong learning	P7
43	Self-regulation in the use of generative tools	P8
44	Recognition of the boundaries of permissible use	P8
45	Commitment to producing original content	P9
46	Necessity of developing competency-based objectives	P9
47	Integration of AI education with existing subjects	P10
48	Designing an independent course unit	P10
49	Inclusion of AI ethics topics	P11
50	Age-based content leveling	P11
51	Localization of educational content	P12
52	Vertical continuity in the curriculum	P12
53	Horizontal coherence among courses	P13
54	Emphasis on practical application	P13
55	Designing problem-based content	P14
56	Attention to the future of occupations	P14
57	Alignment with educational transformation documents	P15
58	Curriculum flexibility	P15
59	Use of project-based learning	P1
60	Utilization of exploratory methods	P1
61	Problem-based instruction	P2
62	Practical workshops using AI tools	P2
63	Collaborative learning	P3
64	Case study analysis	P3
65	Simulation of real-life situations	P4
66	Use of ethical scenarios	P4
67	Integration of face-to-face and virtual education	P5
68	Challenge-based instruction	P5
69	Performance-based assessment	P6
70	Project-based evaluation	P6
71	Use of portfolios	P7
72	Process-oriented assessment	P7
73	Assessment of AI output analysis skills	P8
74	Evaluation of ethical attitudes	P8
75	Use of self-assessment	P9

76	Combination of written and practical examinations	P9
77	Need for teacher training	P10
78	Enhancement of teachers' technological literacy	P10
79	Provision of stable internet infrastructure	P11
80	Equal student access to tools	P11
81	Development of national policymaking	P12
82	Managerial support from schools	P12
83	Allocation of a specific budget	P13
84	Production of standardized educational resources	P13
85	Establishment of an executive guideline framework	P14

In the axial coding stage, the primary objective was to aggregate similar open codes into conceptual components, identify logical relationships among the codes, and establish an organized framework of initial concepts for extracting the main dimensions of the effectiveness of AI-based virtual education.

Table 3. Axial Coding

Dimension	Component	Related Open Codes	Interview Number
Cognitive Domain Concepts	Theoretical Foundations of Artificial Intelligence	1, 2, 3, 5, 7	P1
	Understanding the Operational Mechanisms of Intelligent Systems	4, 6, 10, 12	P1
	Recognition of AI Limitations and Errors	9, 11	P2
	Familiarity with the Transformational Applications of Artificial Intelligence	8, 14, 15	P2
Skill Domain Concepts	Skills in Using Artificial Intelligence Tools	16, 22, 25	P3, P3, P4
	Skills in Analyzing and Evaluating AI Outputs	18, 20, 23, 28	P4
	Skills in Effective Interaction with Generative Systems	17, 21, 29	P3
	Problem-Solving and Knowledge Production with AI Assistance	24, 26, 27, 30	P6
Attitudinal and Ethical Domain Concepts	Digital Responsibility	31, 40, 43	P6, P7
	Ethics and Intellectual Property	32, 36, 44, 45	P5, P5
	Justice and Algorithmic Bias	37, 39	P8, P8
	Critical Attitude and Self-Regulation	34, 35	P9, P13
	Future Orientation and Lifelong Learning	41, 42, 38	P9
Curriculum Domain Concepts	Competency-Based Objectives	46, 56	P8, P8
	Content Organization and Integration	47, 48, 50, 52, 53	P10, P9
	Localization and Alignment with Educational Documents	51, 57, 58	P10
	Emphasis on Application and Problem Orientation	54, 55	P11, P11, P9, P9
Teaching Method Domain Concepts	Active and Project-Based Learning	59, 60, 61, 62, 63, 64, 65, 66, 67, 68	P12, P8, P8
Assessment Domain Concepts	Performance-Based and Process-Oriented Assessment	69, 70, 71, 72	P7, P7
	Assessment of AI Skills and Attitudes	73, 74, 75, 76	P13, P15
Executive Requirement Domain Concepts	Teacher Empowerment	77, 78	P14, P14
	Technological Infrastructure	79, 80	P4, P1
	Policy and Managerial Support	81, 82, 83	P15
	Production of Resources and Guidelines	84, 85	P13, P12

The results presented in the axial coding table indicated that each component emerged from the conceptual clustering of several similar open codes. This table served as the basis for extracting sub-indicators for each component and ultimately for identifying the seven-dimensional model of the curriculum based on artificial intelligence literacy. The interview numbers demonstrate from which expert responses each code was extracted, thereby contributing to the preservation of internal validity and the representation of viewpoints.

In selective coding, the objective is to connect all open codes and components within the framework of core dimensions and key concepts. This stage contributes to the development of an integrated conceptual model for the optimal curriculum based on artificial intelligence literacy education. In practice, selective coding involves identifying the core category, related dimensions, and relationships among the dimensions. All 85 open codes and the six main dimensions were integrated and consolidated across three levels of abstraction (open code → component → dimension).

Table 4. Selective Coding

Dimension	Components	Key Indicators / Abstract Concepts	Description
Cognitive Competencies	Theoretical Foundations of Artificial Intelligence	Understanding concepts of machine learning, data, algorithms, and neural networks	Establishing a conceptual foundation for scientific understanding of AI
	Understanding the Operational Mechanisms of Intelligent Systems	Understanding algorithmic decision-making logic and data processing	Promoting deep understanding rather than superficial consumption of technology
	Recognition of AI Limitations and Errors	Algorithmic error, AI hallucination, uncertainty	Strengthening a realistic and critical perspective
Skill Competencies	Familiarity with the Transformational Applications of Artificial Intelligence	Transformation in education, healthcare, and industry	Connecting theoretical knowledge to real-life contexts
	Skills in Using Artificial Intelligence Tools	Working with generative tools and intelligent search systems	Developing practical technology utilization abilities
	Skills in Analyzing and Evaluating AI Outputs	Validation and bias detection	Enhancing critical thinking
	Skills in Effective Interaction with Generative Systems	Prompt engineering and purposeful interaction	Improving the quality of human-machine interaction
Attitudinal and Ethical Competencies	Problem-Solving and Knowledge Production with AI Assistance	Knowledge co-creation and decision-making	Transforming AI into a cognitive tool
	Digital Responsibility	Accountability and data security	Developing digital citizenship
	Ethics and Intellectual Property	Respecting authorship rights and transparency in usage	Preventing academic misuse
	Justice and Algorithmic Bias	Algorithmic equality and cultural sensitivity	Awareness of the social consequences of technology
	Critical Attitude and Self-Regulation	Self-regulation and consequence evaluation	Fostering learner agency
Curriculum Components	Future Orientation and Lifelong Learning	Career readiness and lifelong learning	Adapting to technological transformations
	Competency-Based Objectives	Competency-based learning	Focusing on actual abilities rather than memorization of content
	Content Organization and Integration	Interdisciplinary integration	Linking AI with various academic subjects
	Localization and Alignment with Educational Documents	Alignment with transformational educational documents	Consistency with educational policies
Teaching–Learning and Assessment Strategies	Emphasis on Application and Problem Orientation	Learning within real-world problem contexts	Enhancing applicability of knowledge
	Active and Project-Based Learning	Project-based and collaborative learning	Promoting deep cognitive engagement
	Performance-Based and Process-Oriented Assessment	Process-oriented assessment	Emphasizing gradual competency development
Executive Requirements and Contexts	Assessment of AI Skills and Attitudes	AI competency rubrics	Comprehensive evaluation of learning dimensions
	Teacher Empowerment	Continuous professional development	Ensuring implementation quality
	Technological Infrastructure	Equal access and security	Providing the implementation platform
	Policy and Managerial Support	Regulation and macro-level governance	Ensuring sustainability of transformation
	Production of Resources and Guidelines	Guidelines and localized content	Practical support for curriculum implementation

Table 4 demonstrates that the core category is the “Curriculum Model Based on Artificial Intelligence Literacy,” which integrates all dimensions within a unified framework. The six identified dimensions, including cognitive competencies, skill competencies, attitudinal and ethical competencies, curriculum components, teaching–learning and assessment strategies, and executive requirements and contexts, integrated the open codes and conceptual components.

To assess the reliability of the designed model, the Kappa coefficient was utilized. The Kappa coefficient is a statistical measure that evaluates the degree of agreement between two evaluators or two classification methods while taking random agreement into account. When two individuals or two models assign labels to the same dataset, the Kappa coefficient determines the extent to which the agreement is genuine rather than accidental. Ultimately, the Kappa coefficient was calculated based on the number of similar and dissimilar concepts identified.

Table 5. Kappa Coefficient

Agreement Criterion	Value	Standard Error	Tb	Sig.
Kappa	0.758	0.105	7.219	0.000
Number of Codes	85			

Table 6. Status of the Kappa Coefficient

Numerical Value of the Kappa Coefficient	Agreement Status
Less than 0	Weak
0 to 0.20	Insignificant
0.21 to 0.40	Moderate
0.41 to 0.60	Acceptable
0.61 to 0.80	Valid
0.81 to 1.00	Excellent

As shown in Table 6, the calculated Kappa coefficient was 0.758, which, according to the classification presented in Table 6, indicates a valid level of agreement.

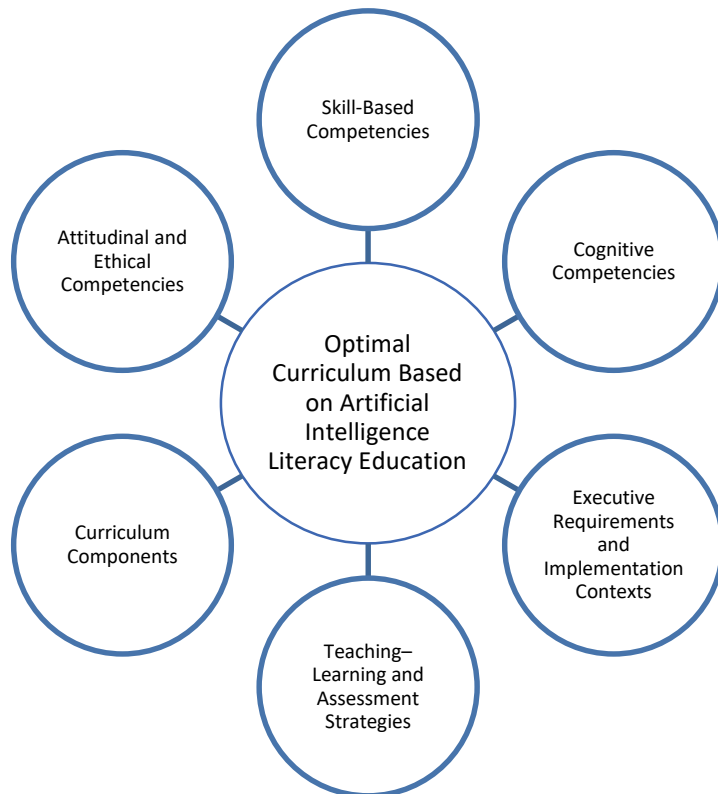


Figure 1. Final Research Model (Derived from the Research Findings)

Discussion and Conclusion

The present study aimed to design a conceptual model of a curriculum based on artificial intelligence literacy education. The findings derived from the three-stage coding process demonstrated that the proposed model consists of six major dimensions, including cognitive competencies, skill-based competencies, attitudinal and ethical competencies, curriculum components, teaching–learning and assessment strategies, and executive requirements and contexts. The findings indicated that artificial intelligence literacy should not be conceptualized merely as technical familiarity with digital tools; rather, it should be understood as a multidimensional educational construct integrating conceptual understanding, practical capability, ethical awareness, pedagogical organization, and institutional readiness. The extracted dimensions collectively suggest that effective AI literacy education requires a systemic and curriculum-oriented approach capable of preparing students for technological, social, and professional transformations associated with the expansion of artificial intelligence in educational and occupational environments.

One of the most important findings of the study was the identification of cognitive competencies as a foundational dimension of AI literacy education. Components such as understanding the theoretical foundations of artificial intelligence, recognizing the operational mechanisms of intelligent systems, identifying limitations and algorithmic errors, and understanding the transformational applications of AI reflected the importance of conceptual knowledge in AI literacy curricula. These findings are aligned with studies emphasizing that AI literacy requires learners to understand machine learning, algorithms, data structures, neural networks, and intelligent decision-making processes rather than simply interacting with AI applications superficially (2, 3). The results are also consistent with research showing that AI-supported education should cultivate deep conceptual understanding to enable learners to evaluate AI outputs critically and recognize technological limitations (17). The emphasis on understanding AI limitations and algorithmic errors is particularly important because students increasingly interact with generative systems capable of producing inaccurate, biased, or fabricated content. Therefore, developing realistic and critical perspectives toward AI appears essential for responsible educational use.

The findings further demonstrated that skill-based competencies constitute another core dimension of AI literacy education. Components such as the ability to use AI tools, analyze and evaluate AI-generated outputs, interact effectively with generative systems, and solve problems through AI-supported knowledge production indicate that learners require practical competencies alongside conceptual understanding. These findings correspond with studies highlighting that AI literacy involves operational and analytical skills enabling learners to utilize intelligent systems in meaningful educational contexts (4, 7). The identification of prompt engineering and effective interaction with generative systems as key competencies is particularly consistent with recent educational discussions surrounding human–machine interaction and intelligent content generation. Previous studies have emphasized that AI-supported learning environments require learners to formulate purposeful requests, validate generated responses, and integrate human judgment with technological outputs (1, 8). Consequently, the findings suggest that AI literacy curricula should include authentic opportunities for students to engage with AI tools in practical, reflective, and problem-oriented learning activities.

Another major finding of the study was the identification of attitudinal and ethical competencies as central elements of AI literacy education. Components such as digital responsibility, ethics and intellectual property, awareness of algorithmic bias, critical attitudes, self-regulation, and lifelong learning indicate that AI literacy extends beyond technical competence and encompasses ethical and social dimensions. These findings support prior research demonstrating that ethical awareness and responsible AI use are increasingly necessary in educational contexts where learners interact with generative AI systems, intelligent recommendation algorithms, and automated decision-making technologies (11, 12). The emphasis on intellectual

property and plagiarism prevention is particularly significant because AI-generated content may blur the boundaries between original authorship and automated production. Similarly, awareness of algorithmic bias and social consequences aligns with studies suggesting that AI systems may reproduce inequalities or reinforce cultural and institutional biases if learners are not equipped with critical perspectives (13, 17). Therefore, the present findings reinforce the argument that AI literacy education should promote ethical reasoning, accountability, and critical engagement with technology.

The results additionally highlighted the importance of future orientation and lifelong learning within AI literacy curricula. This finding suggests that AI literacy is not confined to present technological needs but is fundamentally connected to preparing learners for continuous adaptation in rapidly evolving technological societies. Previous studies similarly indicate that AI is reshaping labor markets, professional competencies, and educational expectations, thereby requiring learners to develop adaptive learning capacities and future-oriented thinking (2, 19). The integration of lifelong learning into the curriculum model reflects recognition that AI technologies continuously evolve and that learners must remain capable of updating their knowledge, evaluating emerging tools, and responding flexibly to technological transformation. Consequently, the findings position AI literacy as a dynamic educational process rather than a fixed set of technical skills.

The dimension related to curriculum components also emerged as a critical finding of the study. The results demonstrated that competency-based objectives, content organization and integration, localization and alignment with educational documents, and emphasis on application and problem orientation are essential aspects of AI literacy curriculum design. These findings are consistent with contemporary curriculum theories emphasizing interdisciplinary learning, competency-based education, and authentic problem-solving (5, 20). The emphasis on integrating AI education with existing subjects indicates that AI literacy should not necessarily be isolated as a separate discipline but can function as a cross-curricular educational framework. Previous research has similarly shown that AI is increasingly relevant in entrepreneurship education, vocational education, creative education, and ideological and political education (6, 18, 21). Therefore, the present findings suggest that AI literacy curricula should facilitate interdisciplinary connections between technological competencies and broader educational objectives.

The emphasis on localization and alignment with educational transformation documents is another noteworthy aspect of the findings. The participants stressed the necessity of adapting AI literacy curricula to local educational contexts, institutional realities, and cultural frameworks. This finding aligns with studies emphasizing that educational innovation should be context-sensitive and aligned with national educational priorities and cultural values (23, 24). AI literacy models developed in one educational environment may not automatically be applicable to another context because educational systems differ in technological infrastructure, policy orientation, teacher preparation, and social expectations. Therefore, localization appears to be an essential condition for sustainable and meaningful curriculum implementation.

The findings related to teaching–learning and assessment strategies demonstrated that active and project-based learning, collaborative learning, challenge-based learning, ethical scenario analysis, and performance-based assessment are highly relevant for AI literacy education. These findings correspond with research indicating that AI-supported education is most effective when instructional approaches emphasize learner engagement, inquiry, collaboration, and authentic problem-solving (1, 15). The identification of project-based and collaborative learning as core strategies reflects the understanding that AI literacy develops through active interaction rather than passive information reception. Furthermore, the emphasis on performance-based and process-oriented assessment supports previous studies arguing that AI literacy cannot be evaluated solely through traditional written examinations (3). Since AI literacy includes practical, analytical, ethical, and attitudinal competencies, assessment strategies must evaluate how students use AI systems, interpret outputs, make judgments, and solve

authentic problems. Thus, the present findings reinforce the need for multidimensional assessment frameworks in AI literacy education.

The executive requirements and contextual dimensions identified in the study further demonstrated that curriculum implementation depends on institutional and organizational readiness. Components such as teacher empowerment, technological infrastructure, policy and managerial support, and the production of educational resources and guidelines indicate that AI literacy education requires systemic support mechanisms. These findings align closely with studies emphasizing that successful AI integration in education depends on teacher professional development, educational leadership, infrastructure availability, and institutional governance (9, 16). The emphasis on teacher empowerment is particularly significant because teachers mediate students' engagement with AI technologies and determine how AI is integrated into instructional practices. Research has shown that teachers require technological literacy, pedagogical adaptation, ethical awareness, and confidence in using intelligent systems effectively (7, 22). Therefore, the findings suggest that teacher training programs should be redesigned to address AI literacy comprehensively.

The findings regarding technological infrastructure and equal access to AI tools are also consistent with concerns expressed in previous studies about educational equity and digital inclusion. AI-supported education cannot achieve its intended goals if learners experience unequal access to intelligent technologies, unstable internet connectivity, or insufficient institutional support. Earlier studies similarly highlighted that educational transformation through AI requires sustainable infrastructure, digital security, and equitable technological access (16, 17). Consequently, policymakers and educational leaders must recognize that AI literacy education is not solely a curricular issue but also an infrastructural and policy-related challenge.

Another important implication of the findings concerns the role of educational leadership and managerial support. The results indicated that policy development, managerial support, and executive guidance frameworks are necessary for implementing AI literacy curricula effectively. These findings correspond with studies emphasizing that AI integration in educational institutions requires strategic leadership capable of coordinating innovation, governance, resource allocation, and institutional transformation (16, 23). Educational leaders play a decisive role in creating supportive environments for AI-based learning, developing implementation policies, and ensuring alignment between technological innovation and educational values. Therefore, curriculum reform related to AI literacy should involve policymakers, administrators, and school leaders alongside curriculum specialists and teachers.

Overall, the findings of the present study contribute to the expanding literature on AI literacy by proposing an integrated conceptual curriculum model that combines cognitive, skill-based, ethical, pedagogical, and organizational dimensions. While many previous studies have investigated isolated aspects of AI in education, such as teacher attitudes, AI-supported learning tools, leadership, or digital culture, the present study synthesized these dimensions into a unified curriculum-oriented framework. The extracted model therefore provides a comprehensive foundation for designing AI literacy programs capable of responding to educational, technological, ethical, and institutional challenges associated with artificial intelligence in secondary education.

One limitation of the present study was that the findings were derived exclusively from qualitative interviews with experts in a specific geographical and educational context. Although theoretical saturation was achieved, the identified dimensions and components may reflect contextual priorities related to the educational system of the participants. Additionally, the study relied on expert perspectives rather than direct classroom observations or empirical implementation of the proposed curriculum model. Another limitation concerns the rapidly evolving nature of artificial intelligence technologies, which may require continuous updating of AI literacy frameworks and curricular components over time.

Future research is recommended to validate the proposed curriculum model quantitatively across larger and more diverse educational populations. Researchers may also investigate the effectiveness of the model through experimental or quasi-experimental studies examining student learning outcomes, teacher competencies, ethical awareness, and technological readiness. Comparative studies across educational levels, cultural contexts, and academic disciplines may further clarify how AI literacy curricula should be adapted to different learner groups and institutional environments. In addition, future studies may develop and validate assessment instruments specifically designed for measuring AI literacy competencies and ethical engagement.

From a practical perspective, educational policymakers and curriculum planners should prioritize the integration of AI literacy into secondary education through competency-based and interdisciplinary curriculum frameworks. Teacher professional development programs should include practical training in AI tools, ethical AI use, assessment methods, and AI-supported pedagogy. Educational institutions should also invest in technological infrastructure, equitable student access, and the development of localized educational resources and implementation guidelines. Finally, schools should adopt active and project-based instructional approaches that encourage critical thinking, collaboration, ethical reasoning, and responsible interaction with artificial intelligence systems.

Acknowledgments

We would like to express our appreciation and gratitude to all those who helped us carrying out this study.

Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

References

1. Sofologi M, Katsarou D, Tsirides A, Efthymiou E. The Synergy of Artificial Intelligence and Education. 2025:189-202. doi: 10.4018/979-8-3693-7332-3.ch012.
2. Rahimi A. Artificial Intelligence: The Key to Future Education. Tehran: Amini Publishing; 2025.

3. Zhou X, Li Y, Chai CS, Chiu TK. Defining, Enhancing, and Assessing Artificial Intelligence Literacy and Competency in K-12 Education from a Systematic Review. *Interactive Learning Environments*. 2025;33(10):5766-88. doi: 10.1080/10494820.2025.2487538.
4. Perse RJP. Using Artificial Intelligence in High School Education: A Review. 2025. doi: 10.20944/preprints202504.1727.v1.
5. Zheng S. Artificial Intelligence – Driven Design of Aesthetic Education Curricula in Higher Education. *Educ Insights*. 2025;2(6):247-56. doi: 10.70088/ta9v8365.
6. Wang B. Reflections on Artificial Intelligence Enabling the Precision Development of Ideological and Political Education in Colleges and Universities. *Applied Mathematics and Nonlinear Sciences*. 2025;10(1). doi: 10.2478/amns-2025-0304.
7. Rattanakha R, Hinson K, Wannapiroon P, Wannapiroon N, Jitsupa J, Sookpreedee N. Artificial Intelligence Competencies of Vocational Teachers Using for the Design of Learning Activities. *International Journal of Evaluation and Research in Education (Ijere)*. 2025;14(4):3336. doi: 10.11591/ijere.v14i4.32334.
8. Tahir MS, Noor A, Raza H. Explore the Role of Artificial Intelligence to Support Teachers at Higher Education Institutions in South Punjab. *CRSSS*. 2025;3(3):2421-33. doi: 10.59075/c098vs88.
9. Parseh J, Zafari F, Abroumandi Pi F, Abedi A, editors. Examining the role of artificial intelligence in education and the professional empowerment of teachers. *First International Conference on Artificial Intelligence in Education, Psychology, Educational Sciences, and Religious, Cultural, Social, and Managerial Studies in the Third Millennium*; 2025; Bushehr.
10. Скрипка Г. Artificial Intelligence and Media Literacy: Updating Teacher Training Programs. *Open Educational Environment of Modern University*. 2025(18):132-44. doi: 10.28925/2414-0325.2025.1811.
11. Deep PD, Ghosh N, Natoli AP. Artificial Intelligence for Supporting College Students with Attention-Deficit/Hyperactivity Disorder: Cognitive, Emotional, and Ethical Perspectives. *International Journal on Social and Education Sciences*. 2026;8(1):1-17. doi: 10.46328/ijonses.5915.
12. Tabishat M, Hafiz A. Attitudes and Expectations of Health Sciences Students Towards Artificial Intelligence in Medical Education and Professional Communication. *Journal of Ecohumanism*. 2025;4(2). doi: 10.62754/joe.v4i2.6351.
13. Pertiwi PC, Segoh D, Rohmadhani A. Artificial Intelligence in Academic Environments: Reducing or Increasing Foreign Language Anxiety? *Inspiring English Education Journal*. 2025;8(1):100-31. doi: 10.35905/inspiring.v8i1.13009.
14. Raissouni D, Hrich N, Reklouki K, Eloualkadi A, editors. *Advancing Towards an Educational Revolution: Artificial Intelligence's Contribution to Developing Soft Skills for Future Educators* 2025.
15. Zogopoulos K, Gioti L, Raptis N, Karatzas A. Teaching soft skills to students through artificial intelligence. *IOSR Journal of Research & Method in Education*. 2025;15(1):23-33.
16. Sposato M. Artificial intelligence in educational leadership: a comprehensive taxonomy and future directions. *International Journal of Educational Technology in Higher Education*. 2025;22(1):20. doi: 10.1186/s41239-025-00517-1.
17. Padua D. Artificial Intelligence and Quality Education: The Need for Digital Culture in Teaching. *Journal of Educational Cultural and Psychological Studies (Ecps Journal)*. 2025(30). doi: 10.7358/ecps-2024-030-padd.
18. Elsa D, Islami N, Mahdum M, Copriady J, Putra ZH. Transforming Entrepreneurship Education in the Age of Artificial Intelligence: A Bibliometric Review and Future Research Agenda. 2026. doi: 10.1007/s41959-026-00174-z.
19. Rani S. Synergizing Artificial Intelligence and HRM for Circular Economy Transition: A Conceptual Framework. *The International Journal of Education Management and Sociology*. 2025;4(4):124-37. doi: 10.58818/ijems.v4i3.205.
20. Wang Q. Research on the Training Mode of Animation Professionals in the Era of Artificial Intelligence. *Advances in Education Humanities and Social Science Research*. 2025;13(1):444. doi: 10.56028/aehtsr.13.1.444.2025.
21. Yin M, Yu W, Li W. Innovation and Practice of Ideological and Political Education Communication Mode Driven by Artificial Intelligence. *Applied Mathematics and Nonlinear Sciences*. 2025;10(1). doi: 10.2478/amns-2025-0559.

22. Yehya FM, ElSayary A, Murshidi GA, Zaabi AA. Artificial Intelligence Integration and Teachers' Self-Efficacy in Physics Classrooms. *Eurasia Journal of Mathematics Science and Technology Education*. 2025;21(8):em2679. doi: 10.29333/ejmste/16660.
23. Sadeghi Z, Shafie Pour Motlagh F. Designing a Model for Empowering Managers of Entrepreneurial Schools Utilizing Artificial Intelligence. *Entrepreneurship Education and Management*. 2025;4(1):71-92.
24. Rah Shabdeez R, Hasan Zadeh Z, editors. Hijab and 'Ifaf in the Art of Fashion Design. *The 1st International Conference on Artificial Intelligence in Education, Psychology, Educational Sciences, and Religious, Cultural, Social, and Managerial Studies in the Third Millennium*; 2025; Bushehr.